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(54) A LOADING AND TRANSPORTING DEVICE WITH WEIGHING EQUIPMENT

(71) We, PINDSTRUP FODERINDUSTRI A/S, a company organized under the laws of Denmark, of 8550 Ryomgård, Denmark, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a self-propelled loading and transporting device for bulk material which device includes a bucket, a hydraulic ram for lifting and lowering the bucket, a pressure sensor connected to said hydraulic ram and means for pivoting the bucket about a horizontal axis between a loading/unloading position and a transport position.

With devices of this kind, which are known from published German Patent Application No. 24 12 402, it is possible, by means of the pressure sensor, to weigh the contents of material within the bucket when the bucket has been pivoted about the horizontal axis to a predetermined angular position in which the moment arm of the weight load acting on the hydraulic ram assumes a predetermined length. The hydraulic pressure prevailing in the cylinder of the ram is then proportional to the load. The pressure sensor may be a calibrated and tared gauge (manometer) which permits a direct indication of the weight of the bulk material on the scale of the gauge. Alternatively, or as a supplement to the calibrated gauge there may be provided electronic equipment for converting the ram pressure to a digital output signal.

According to the present invention there is provided a self-propelled loading and transporting device for bulk material, comprising a frame, a bucket having a front wall portion, a rear wall portion and two side walls which together define a loading/unloading opening, and a bottom wall portion connecting said front and rear wall portions, a hydraulic ram connecting said frame and said bucket for lifting and lowering the bucket, means for weighing the contents of the bucket, means for pivoting said bucket about a horizontal axis between a loading/unloading position and a transport position, a conveyor screw mounted for rotation about a substantially horizontal axis within the bucket adjacent that part of the bottom wall portion thereof which in the loading/unloading position is furthest from said loading/unloading opening, an aperture in one of said side walls, said conveyor screw having a discharge and adjacent to said aperture, sealing means associated with the discharge end of the conveyor screw for preventing loss of material from the bucket, and a hydraulic motor operatively connected to said conveyor screw.

The invention thus provides equipment which can be used not only for weighing an amount of material contained in the bucket, but also for the apportioning of desired amounts of the material. For doing this, an amount of material larger than desired is first introduced into the bucket, e.g. by driving the bucket into a heap of material lying on the earth or on the floor of a store-room. Then the bucket is lifted and pivoted to the previously mentioned angular position (weighing position), the weight of material is read by the pressure sensor following which the drive motor of the conveyor screw is started whereby the screw removes excess material through the aperture in the bucket side wall. When the sensor indicates that the bucket contains the desired amount of material, the motor is stopped and the device can now be driven to the place where the material is to be unloaded.

The location of the conveyor screw close to the bottom wall portion ensures that when the bucket is in the weighing position corresponding to its maximum load capac-

ity, the screw is located by and large vertically below the center of gravity of the bulk material. Consequently, the downward movement of material, which accompanies the removal of excess material, does not result in any substantial displacement of the center of gravity which could introduce an error in the measurement. The weight of the material in the bucket above the conveyor screw is sufficient to ensure the continuous supply of fresh material to the helix of the screw in timed relationship with the removal of excess material through the aperture in the side wall. The sleeve surrounding the discharge end of the screw acts as a sealing means to ensure that during the transportation of the material to the place of unloading, no material will be lost through the aperture in the side wall notwithstanding the fact that the aperture is below the surface of the material in the bucket.

The possibility of apportioning the bulk material directly in the transport bucket in connection with the loading operation results in a substantial saving of working time and costs, whether the device is used for transporting desired amounts of feeding stuff, fertilizer, grain etc. from a storage place to a lorry or railway wagon for further transportation, or for moving measured quantities of different kinds of bulk material to a mixing plant which may be located at a considerable distance from the place or places where the materials are stored. Particularly for mixing operations there is obtained a considerable simplification compared to conventional mixing plants including hoppers with associated separate dispensing devices for the constituents of the mixture, and the apportioning can be effected very precisely independent of variations in the bulk density of the constituents which in conventional plants with volumetric metering can only be compensated for by frequent adjustments. The location of the conveyor screw close to the bucket wall ensures that during loading of the bucket the screw will not be subjected to excess bending stresses or other mechanical load exerted by the bulk material which may be pressed into the bucket with a large force when the loading device is driven into a heap of the material.

A sufficient sealing action of the sleeve can generally be obtained when the length of said sleeve is substantially equal to the pitch of the conveyor screw. Even with a relatively short conveyor screw having a corresponding high rigidity against bending, a substantial part of the screw windings will be exposed to the material in the bucket, and this ensures a rapid removal of the excess material in response to the rotation of the screw.

It is preferred that the hydraulic drive motor of the conveyor screw is a reversible, infinitely variable motor. By reversing the rotation of the conveyor screw during unloading of the bucket, the quantity of material contained within the sleeve may be moved back into the bucket and unloaded together with the remainder of the material. During the apportioning the rotational speed of the screw may be varied, if desired continuously, to adjust the discharge speed in accordance with the amount of excess material which is to be removed.

The invention will be described in more detail with reference to the accompanying drawings in which

Figure 1 is a somewhat schematical perspective view of a loading and transporting device embodying the present invention,

Figure 2 is a section on a larger scale through the bucket of the device shown in the loading position, the section being taken along line II-II of Figure 3, and

Figure 3 is a view of the bucket in the direction of arrow III in Figure 2.

The loading and transporting device shown comprises a tractor 1 on which a bucket 2 is mounted by means of a pair of supporting arms 3 hinged to the frame of the tractor and connected to a pair of hydraulic rams 4 for pivoting the arms and thus lifting or lowering the bucket. In Figure 1 one wheel of the tractor has been partially cut away to show the ram located on that side of the tractor behind the wheel.

Bucket 2 is hinged to the front end of each arm 3 and adapted to be pivoted about a horizontal axis by means of a linkage generally designated by 5 and actuated by a further hydraulic ram 6.

Bucket 2 includes a flat front wall portion 7, a rear wall portion 8, a curved bottom wall portion 9 and two side walls 10. In one of the side walls there is a circular aperture 11 surrounded by a cylindric sleeve 12 secured to the inner surface of wall 10 by means of a flange 13.

In the outermost end of sleeve 12 a bearing sleeve 14 is welded to the bucket by means of arms 15. Sleeve 14 supports the outer end of a conveyor screw 16, the opposite end of which is connected to the output shaft of a hydraulic motor 17 by means of a coupling (not shown). Motor 17 is bolted to the inner surface of bottom wall portion 9. Through hydraulic conduits 18 and 19 motor 17 is connected to the hydraulic system (not shown) of the device which may include a throttling and reversing valve in the cabin of the tractor.

As shown in Figure 2 the aperture 11 in side wall 10 is formed so close to the bottom wall portion 9 that the rear side of sleeve 12 is practically in contact with that wall portion. The length of sleeve 12 is substantial equal to the pitch of screw 16, as shown

in Figure 3.

When a predetermined amount of a bulk material, which may be in the form of grain, flakes or powder, is to be apportioned from a heap of the material in question by means of the device shown, rams 4 are first actuated to lower bucket 2 from the transport position shown in Figure 1 to the surface which supports the heap and on which the device can be moved around. By means of ram 6 bucket 2 is pivoted to the loading position shown in Figure 2 in which front wall portion 7 is horizontal. The loading and transporting device is then driven into the heap whereby a quantity of the material enters the bucket, and the operator makes sure that this quantity is somewhat larger than desired. During loading of the bucket conveyor screw 16, which is located at the rearmost wall portion of the bucket, is protected from excessive bending stresses resulting from the accompanying compression of the bulk material.

The loaded bucket is then lifted by means of rams 4 and pivoted to the weighing position shown in Figure 1, in which one of the arms 3 may be aligned with a pointer (not shown) secured to the cabin and which can be observed by the operator. A pressure gauge 20 provided in the cabin and connected to rams 4 permits the operator to ascertain the weight of the bulk material in the bucket and accordingly determine the magnitude of the excess amount of material, i.e. the difference between the content of the bucket and the desired amount. Gauge 20 may be calibrated to indicate directly the net weight of material in the bucket. While the bucket is maintained in the weighing position the operator now actuates the control valve of motor 17 to start rotation of screw 16 for removing material from the bottom of the bucket through aperture 11. By monitoring gauge 20 the operator may stop the removal of material at the moment when the remaining amount of material is exactly equal to the desired amount. If necessary or desired, the removal of excess material may be effected in successive steps whereby motor 17 may be stopped between the steps for better permitting the operator to read gauge 20. The rotational speed of motor 17 may also be successively reduced as the amount of material in the bucket approaches the desired value.

When the apportioning operation has been terminated, sleeve 12 and that part of screw 16, which is surrounded by the sleeve, act as a sealing means which effectively prevents material from running out through aperture 11 when the device is driven to a remote place of unloading. It will be seen from Figure 3 that the relatively short length of sleeve 12 provides acess for the bulk material to a substantial length of conveyor screw 16 so that even materials less inclined to slide down will be caught by the windings of the screw. In the weighing and transport position of bucket 2 screw 16 is located substantially vertically below the center of gravity of the bulk material in the bucket so that the removal of the relatively small amount of excess material does not materially influence the accuracy of the measurement.

It may be noted that for taring gauge 20, which implies measuring the oil pressure in rams 4 when the bucket is empty, and for calibrating the gauge which can be effected with a precisely weighed amount of bulk material in the bucket, it is necessary to bring the bucket to the described weighing position.

It has been found that the loading and transporting device described permits apportioning of quantities of 600 to 800 kg with an accuracy of about 2%, and that an experienced operator can perform a weighing and apportioning operation in less than $\frac{1}{2}$ minute.

While the invention has been described above in connection with manually controlled actuation of the bucket and the conveyor screw, it will be understood that these operational steps could be performed automatically by means of suitable control equipment which halts the bucket in the weighing position, starts the rotation of the conveyor screw, and subsequently stops it when the excess amount of material has been discharged from the bucket. Such equipment could also include an adding counter which indicates the total amount of bulk material apportioned during a certain period of operation.

WHAT WE CLAIM IS:-

1. A self-propelled loading and transporting device for bulk material, comprising a frame, a bucket having a front wall portion, a rear wall portion and two side walls which together define a loading/unloading opening, and a bottom wall portion connecting said front and rear wall portions, a hydraulic ram connecting said frame and said bucket for lifting and lowering the bucket, means for weighing the contents of the bucket, means for pivoting said bucket about a horizontal axis between a loading/unloading position and a transport position, a conveyor screw mounted for rotation about a substantially horizontal axis within the bucket adjacent that part of the bottom wall portion thereof which in the loading/unloading position is furthest from said loading-unloading opening, an aperture in one of said side walls, said conveyor screw having a discharge end adjacent to said aperture, sealing means associated with the discharge end of the conveyor screw for preventing loss of material from the bucket,

and a hydraulic motor operatively connected to said conveyor screw.

2. A self-propelled loading and transporting device as claimed in claim 1, wherein said sealing means is a sleeve secured to said one side wall around said aperture therein and extending into the bucket with a narrow radial clearance from the discharge end of the conveyor screw.

3. A self-propelled loading and transporting device as claimed in claim 2, wherein the length of said sleeve is substantially equal to the pitch of said conveyor screw.

4. A self-propelled loading and transporting device as claimed in claim 2 or claim 3, wherein said sleeve is located wholly within the bucket.

5. A self-propelled loading and transporting device as claimed in any one of the preceding claims, wherein the hydraulic motor is disposed within the bucket.

6. A self-propelled loading and transporting device as claimed in claim 5, wherein an output shaft of the hydraulic motor is directly connected with the end of the conveyor screw remote from said discharge end.

7. A self-propelled loading and transporting device as claimed in any one of the preceding claims, wherein said hydraulic motor is a reversible, infinitely variable motor.

8. A self-propelled loading and transporting device as claimed in any one of the preceding claims, wherein said means for weighing the contents of the bucket comprises a pressure sensor connected to the hydraulic ram which connects the frame and the bucket.

9. A self-propelled loading and transporting device for bulk material, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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Sheet 1

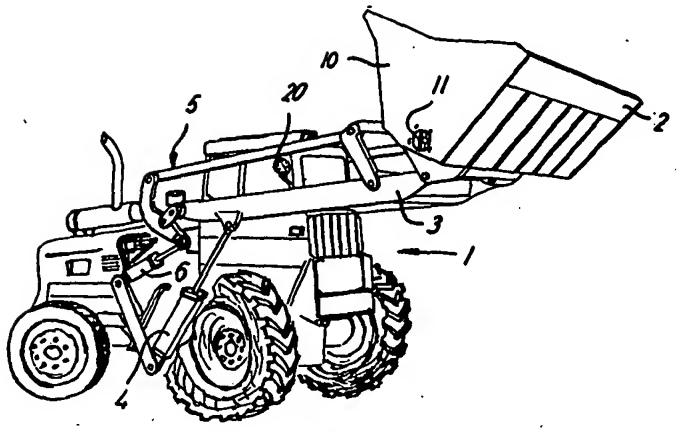

FIG. 1

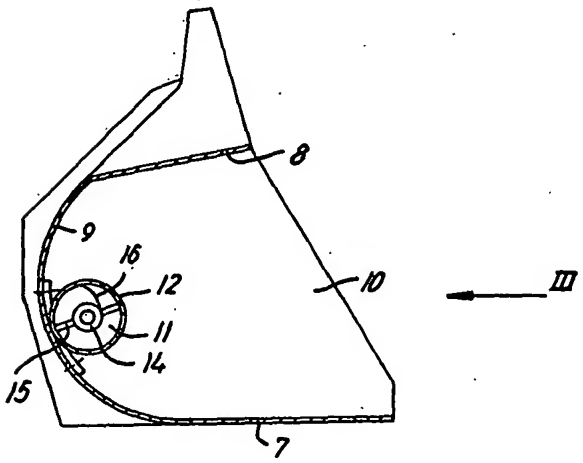

FIG. 2

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Sheet 2

FIG.3